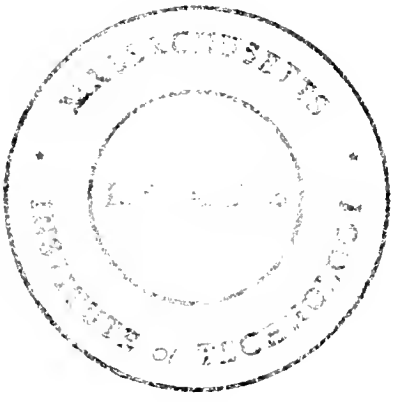
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Applying Innovation Diffusion Theory to The Management of Change

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Introduction

Management today usually involves, at some level, the management of change -- the introduction of innovation either into one's own or into a client organization. While the most visible symbol of that change may be hardware (e.g., an office automation system), significant technological changes are always accompanied by social and psychological change as well. In fact, both the slope and the shape of the S-shaped curve which describes the dissemination of an innovation among adopters (see Figure 1) are heavily influenced by social and psychological responses to the way the innovation diffusion process is managed. This paper sets out several advances in the theory of innovation diffusion which seem especially relevant to management problems and the introduction of new technologies.

Before enumerating those additions to traditional diffusion theory, a few words about the general theory are needed. Advocates of an innovation explore the dynamics of diffusion in order to accelerate change and avoid implementation pitfalls. As in the case of marketing or implementation theory, there is an implicit pro-innovation bias in the approach. However, diffusion issues are seldom limited to the process of "selling" an innovation. In the great majority of studies out of which diffusion theory has grown, the acceptance of the innovation being researched required of the adopter a significant commitment in financial, psychological and/or social terms. That is, the adopter had to make some

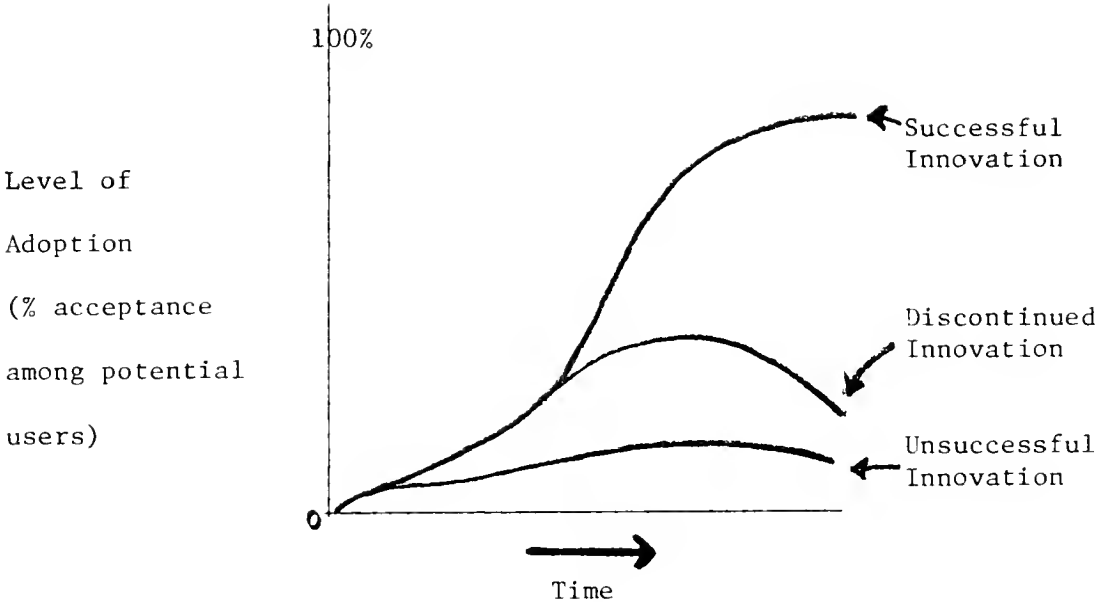

Figure I

Curves Describing Alternative Innovation Diffusion Patterns

kind of major shift from current practice, often undergoing a change in skills as well as in financial investment patterns.

The issues inherent in introducing such major innovations involve the potential adopter at a much deeper level than do those inherent in selling soap or toothpaste. When peoplego to the store for toothpaste, they already know they need it; our society has established a norm of bodily cleanliness. The sellers of toothpaste almost never address themselves to arousing the basic need for the generic product. Instead they attempt to "channel" that need towards their brand, to persuade consumers that their particular product satisfies that need better than others. Moreover, the "adoption" of a new brand requires no real value shift, usually no change in habits or method of brushing, and no significantly different outlay of cash than the consumer is you are accustomed to making to satisfy that need.

Frequently, for the types of technological innovation which managers deal with today, the need is as yet unrecognized by potential adopters. Even if the need is acknowledged, such innovations as computerized manufacturing or office systems obviously require enormous managerial skill in directing the diffusion process because of the necessary value and skills changes which accompany the technologies. The manager of change has much more of a challenge than to merely "sell" a technical solution. Whether the manager is positioned in the organization developing and selling the technology or in the client organization, she/he must often anticipate implementation/diffusion issues. Moreover, for customized innovations (e.g., a tailor-made computerized inventory control system, or for extensively adapted ones (e.g., process machinery

for specialized manufacturing), those issues must be addressed at the time the technology is still under development. In the rest of this paper, I will discuss the implications of the four implementation questions listed below, first by briefly sketching in elements of the traditional diffusion model and then discuss recent developments which expand on that traditional theory:

1. Are adopters and users the same people?
2. Is the innovations still evolving?
3. Is a vertical or horizontal diffusion strategy more appropriate?
4. Is there adequate infrastructure to support diffusion?

Innovation Adopters versus Users

Researchers in both marketing and innovation diffusion have generally assumed that the ultimate user or beneficiary of the innovation is one and the same person as the decision-maker, or the "adopter" (See Kotler, 1976; especially Chapter 4; Rogers with Shoemaker, 1971). That is, an individual (1) becomes aware of the new product, service or technology, (2) seeks information about the innovation (often from interpersonal sources of communication) and, after considering the relative advantages of the new over the old, (3) decides whether or not to adopt. In such a model, the benefits of the decision to adopt accrue to the decision-maker, and the innovation decision is regarded as wise if over time, those benefits outweigh the costs paid by that same adopter.

However, usually the organizational decision-maker or adopter of an innovation is not the ultimate user of that innovation, or at least is less directly interactive with the technology than are other users, as for

example, secretaries in the case of word processors or engineers in the case of CAD/CAM systems. The fact that adopter and primary user are not synonymous terms in such cases is obvious; the implications of that simple fact for the successful management of innovation development and implementation are not so obvious.

Psychological Commitment

The adopter of an innovation goes through an evaluative decision-making process which not only informs him of the technical features of the innovation but also invests him with a psychological commitment to the innovation. It is because of this commitment that adopters may rationalize uneconomic purchases (Leonard-Barton, 1981a) or selectively perceive reinforcement for an adoption decision after the fact (Sears and Freedman, 1967) or enthusiastically proselitize for an innovation they have recently adopted. However, secondary adopters, or users who "inherit" the new system from an adopter, do not necessarily inherit the enthusiasm along with the hardware. For example, Californians who bought a house with already installed solar water heating equipment were less tolerant of design flaws and equipment failures than were the original homeowners, who had derived enough psychological benefit from being the first solarized house on the block to offset the costs and discomforts of mechanical flaws (Leonard-Barton, 1981). Similarly, innovation adopters within an organization derive the psychological benefits of innovativeness. Unless the same benefits are transmitted to the users, the disparity between adopters and user satisfaction level will cause problems in implementation.

Feedback to Developers

Secondly, potential adopters can feed back into the technology development process their needs, desires and expectations. Obviously, they will base their evaluative criteria on their own experience and value system. That experience and value system may be consonant with the users', as in the case of a former engineer-turned-manager in a manufacturing firm who is selecting CAD/CAM equipment for the engineering department, but in many cases (e.g., an office manager selecting office automation equipment to be used principally by secretarial staff), the backgrounds, evaluative criteria and value systems of adopter and user are totally different. To the extent that the technology developers perceive the adopters as their market and concentrate on their desires rather than on those of the users, the implementation process will be more difficult downstream.

Diffusion Intermediaries or Information Priests

Probably the most critical implication of the fact that the user and adopter roles are embodied in different people, however, is that the adopter in such cases, is a diffusion intermediary, screening the possible technologies for the user, yet with different criteria in mind. In fact, many technical choices are foreclosed before the ultimate user ever makes an innovation decision. (See Figure 2.) The intermediary is a kind of information priest, posessed of special technical knowledge which may or may not reach the user. Consider as one extreme example, professionals in our society such as dentists. Few patients possess the technical

expertise to question the innovative technologies which a dentist selects for them (see Leonard-Barton, 1982). The dentist is in the position of an information priest, who dispenses such information about new technologies, materials or techniques as he deems desireable and necessary. The ultimate "user" of the dental innovation (the patient) has very little control over what new products and processes are utilized in his mouth and in fact frequently does not even realize he/she is receiving an innovation. Perhaps even more importantly just as technical innovations reach the user through the information priest, so user desires, demands, and complaints reach back to the manufacturers through that same screening mechanism.

Dentists are only a convenient example. Doctors, lawyers, computer consultants, -- all professionals play the role to some extent. The point is, when developing an innovation or in devising strategies to diffuse one, a manager has to be aware of and deal with the divergence between the critical needs of the diffusion intermediary and those of the ultimate innovation beneficiaries. Some innovations may threaten to reduce the prestige of the intermediary (e.g., fourth generation computer languages in the case of programmers; do-it-yourself divorces in the case of lawyers; decay-preventing sealants in the case of dentists) and to de-mystify the profession. Other innovations may enhance the information priests' role, but benefit the user very little (e.g., premature utilization of state-of-the-art technology). Of course, the diffusion intermediary or information priest may in fact evaluate an innovation strictly according to the benefits it offers to the user and may make

every effort to honestly reflect the needs of the user back to the technology developer. His incentives for such accurate interpretation of user needs are: 1) his professional ethic and 2) the potential for a user backlash should the innovation prove to be seriously deficient.

The more knowledgable the user, the riskier it is to design a product or attempt to diffuse an innovation with the intermediary rather than the user in mind. The literature on information systems is full of examples of "counter implementation" (Keen, 1980) and of technology failures, many of which might have been avoided had the change managers explicitly recognized the need to differentiate the evaluations of diffusion intermediaries from those of ultimate users.

The Diffusion of Evolving Technologies

Innovation Attributes

Early diffusion models were derived from research on agricultural innovations such as hybrid seeds or fertilizers. These innovations changed little as they were diffused; the technologies were disseminated after long-term development in federal U.S. Department of Agriculture laboratories and extensive field testing. Researchers studying the diffusion patterns of these innovations and other constant-form new products discovered a number of important influences on innovation acceptance which still prove to be important in similar cases today.

First, these researchers found that certain generic characteristics of the new technology influenced acceptance (Rogers with Shoemaker, 1971). Two are intrinsic to the innovation, and result from design decisions made

by the technology developers and suppliers: Trialability and Observability. Trialability is the extent to which an innovation is divisable into trial-size portions, i.e., the extent to which a potential adopter may experience the innovation benefits with minimal initial resource investment. Observability is the degree to which the innovation may be physically viewed by potential adopters and, even more important, the extent to which the results of innovating may be observed. Obviously, hardware of all types is easier to observe in operation than is software.

The other three characteristics noted by Rogers with Shoemaker (1971) are extrinsic to the innovation itself in the sense that they are all subject to the perceptions of the user and can not really be measured "objectively." These are: Relative Advantage, Complexity and Compatability. The Relative Advantage of an innovation to a user is implicitly based on a kind of cost-benefit evaluation made by the potential adopter to determine all the financial, social and psychological advantages of the innovation over present practice, whatever that may be. Complexity is the extent to which the innovation is perceived as difficult to use or understand. Compatability is the degree to which the innovation fits in with the user's value system and (I would add) the user's current technology.

Opinion Leaders

Another important finding of diffusion researchers over the years was that some adopters served as opinion leaders for the rest of the population. An innovation which received their support diffused more rapidly than if those interpersonal influences were missing (Rogers and Kincaid, 1981).

Evolving Technologies

Although these findings still hold in many cases, the concepts are more useful if one recognizes the fact that many innovations do not remain constant in form during the diffusion process. Some are altered by users during the process of adoption -- improved or at least tailored to the user's individual needs (Rogers and Klepper, 1977). Other technologies are undergoing constant development by manufacturers so that a second generation of a technology may offer adopters a substantially greater relative advantage over its competition than did the first generation. In fact, often the first generation technology has a number of technical "bugs" which only a real enthusiast (or the inventor's mother) would be willing to overlook.

One challenge such evolving technologies pose both to the developers and diffusers is to avoid souring the market for the future. The attributes of the technology (its relative advantage, complexity, etc.) change for the users as the technology evolves. However, adopters who try out the innovation early in its development and who get "burned" are not always aware of the technological progress and can be potent negative opinion leaders. The same word-of-mouth advertising which can greatly speed the diffusion process can work in reverse to slow or halt the market penetration. The traditional diffusion literature does not deal with this problem, but there is some evidence that negative information about an innovation is a much more potent influence on the decision of a would-be adopter than is positive (Midgley, 1977). Moreover, consumers who have an unsatisfactory experience with a product broadcast their complaints more widely than they do a satisfactory experience (Technical Assistance Research Programs, 1981).

Just as in marketing a consumable, one cultivates the "repeat buyer," so in diffusing an evolving technology, one needs to attract the "repeat tryer." Individuals who first experienced the technology with all its early flaws, but who tried it again and thus are aware of its current improved merit, make convincing advocates.

As we know from communication research, people seek two kinds of credibility in influential information sources: "safety" credibility (this person is my peer, is like me and has no axe to grind in giving me the information) and "professional" or "technical" credibility (this person knows what he/she is talking about) (Berlo, and others, 1970). A peer who tried an innovation early, discontinued using it, but has recently re-discovered it, likely possesses both kinds of credibility (Leonard-Barton, 1982).

The greater the original flaws in the technology and, the less "prepared" and "packaged" the innovation (Munson and Pelz, 1980), the more important to the diffusion process is the choice of the first diffusion targets -- those individuals or institutions who are expected to influence the decisions of others. Powerful opinion leaders, in short, are high risk targets for the initial diffusion of an evolving technology. If the first adopters are dissatisfied with their initial use of an evolving technology and are influential, they need to be cultivated as "repeat tryers."

Diffusion Strategies: Vertical versus Horizontal

Vertical Diffusion

The traditional diffusion model, influenced as it was by the cases of agricultural innovations initiated and disseminated by the United States

Department of Agriculture, assumed a vertical, top-down diffusion strategy. Experts originated innovations and officially-designated change agents lowered the perceived complexity of the innovation for the users through training and persuasion.

Horizontal Diffusion

In fact there exist many cases in which users originate (von Hippel, 1976) or significantly alter innovations (Rogers, 1977), and, more germane to the present discussion, disseminate among their peers the information and skills necessary for adoption. Such diffusion, as it occurs informally and unplanned, is a component of the "epidemic" model of diffusion, in which innovations spread naturally through word-of-mouth advertising and interpersonal contacts.

However, there are examples both at an organizational and national level of formal peer information exchange systems set up to take advantage of the fact that, for reasons cited above, people like to learn from their peers (Leonard-Barton 1981b). As Rogers and Shoemaker noted over a decade ago (1971), people often become aware of an innovation through media, but interpersonal influence is much more potent in persuading them to adopt, partly because the interpersonal exchange carries the specific "how-to" information so necessary to implementing a positive adoption decision. In other words, previous adopters (especially if they were also the developers of the innovation) embody much of the expertise needed to transfer technology.

Rather than serving as the sole source and disseminator of innovations, then, a central power may find it possible (and frequently

desireable) to take the role of facilitator, providing resources for more effective peer exchanges about the desired innovation. The resulting "horizontal" diffusion pattern differs extensively from the vertical. (See Table 1.)

A number of highly successful examples exist at a national level (Leonard-Barton and Rogers, 1981). The United States Department of Justice, to name just one, transports law officers who have successfully innovated a new program of crime prevention in their own locale, to other locations at which peers are facing similar problems. Such "site-to-site" visits allow in-depth transfer of information and skills. A community-level example is the Young President's Club of entrepreneurs in the Boston area. A requirement for membership is the agreement to serve as a consultant for two days each year in a peer's firm.

While such exchanges can occur across geographic distance (e.g., between separate sites of the same organization), peer consultants are equally effective within one physical location. A peer consultant can not only provide the desired technical information about how an innovation operates mechanically, but can also address other sometimes subtle but important implementation issues: ways to adjust the innovation to address specialized needs (for which the innovation may not have been exactly designed); pecularities which can cause problems down the road; conduits within the organization for necessary complementary resources; the way to handle the politics of the innovation. Therefore peer consultants make desirable trainors or mentors during the implementation stages of an innovation process. No amount of documentation and paper-embodied advice

	Extremely Centralized Diffusion System	Extremely Decentralized Diffusion System
Who Innovates	R&D laboratories	Users
Who legitimizes	Experts	The adoption process
Who Diffuses	Centralized authority	Users
How the innovation is diffused	Through a hierarchical, structured system using officially designated, professional change agents	Face-to-face, usually through personal contacts; the user serve as unofficial change agents

Figure 2

Major Points of Comparison Among Diffusion Systems

can substitute for access to such people-embodied expertise (see also Bullen, 1982, for example of user-developed computer software innovations transferred among office staff).

However, even within one geographic location, such peer consultancy has to be adequated supported with resources. A peer who is the first to learn how to operate a word processor or who has originated some softwarewhich could be usefully disseminated to others in similar positions throughout the organization, cannot be expected to assume training functions on top of all other duties, and without either resources or training to disseminate the knowledge and skills. Some of the resources which would have been utilized in a centralized dissemination effort should be diverted to the support and recognition of such peer consultants. Moreover, user-innovators may have the desire without the ability to transfer the innovation-related knowledge to their peers. The support provided may usefully include advice and h elp on the transfer process.

The Influence of Infrastructure on Diffusion

Access often shapes the diffusion pattern of an innovation, to an extent largely unrecognized by diffusion researchers until fairly recently. Students of diffusion have long known that the diffusion of many innovations can be portrayed as a process of spatial contagion, like an ink blot spreading out from a central point of early adoption. However, as geographer Lawrence Brown demonstrates (1981), that spatial dispersion pattern is often determined by the presence, absence, or type of supporting infrastructure. Just as, in developing nations,

agricultural innovations are found along the roads providing access to markets for the innovation, so in developed societies and within organizations, innovations flow along the easiest paths, and fastest through channels provided as part of the diffusion strategy. For example, the recycling of cans and bottles in a San Francisco suburb gained much more public acceptance as an innovative energy-conservation practice when a curbside collection system was set up, enormously relieving the disadvantages and complexities of recycling (Leonard-Barton, 1981).

As Allen (1977) has shown in his work on the flow of communication within R&D laboratories, physical distance and even minor barriers (e.g., a single flight of stairs) greatly reduces the flow of communication. If people are more than 30 meters apart, the likelihood of their exchanging technical information falls to practically nil. Likewise, Frohman (1968) found that engineers' use of libraries was in inverse proportion to their physical distance from the facility.

People who are strongly motivated to try an innovation will not be inhibited by lack of infrastructure, unless that lack negates any incentive they might otherwise have to adopt (as in the case of a farmer who lives so far from an access road that his innovative goods would spoil before reaching the market). However, many individuals are likely adopters only when adoption is made convenient and accessible for them. For example the "conformists" among energy consumers in a California study conserved energy so long as it was convenient and their neighborhood ethic supported the practice. Unlike their "Crusader" and "Conserver" peers who conserved for strong personal reasons, "Conformists" stopped conserving when they moved away from the supporting infrastructure (Leonard-Barton, 1981).

The innovation may have to go to potential adopters; physical placement is important, as are clear mechanisms for accessing the innovation. Too often, innovation diffusers assume that raising the awareness of potential adopters and providing information about the benefits of the innovation is enough, whereas a bit more attention to infrastructure would greatly enhance the diffusion efforts. For example, the placement of a word-processor terminal in an office frequently has the effect of selecting first adopters--namely, those physically closest to the machine. If these first adopters are willing or particularly able peer consultants, the diffusion will proceed rapidly. If the first users are disinterested or negative, diffusion will be slowed. Moreover, the centrality of the physical location is important.

Summary

Most innovations require major investments in resources or learning and cannot be "sold like soap." Drawing upon both traditional diffusion theory and elaborations from recent research, this paper has discussed some key considerations in deciding who is the real user, what is the nature of the innovation, and how and where should the innovation be diffused. The major points made are that: 1) Users of an innovation are frequently distinct from adopters, or decision-makers; this distinction should be explicitly recognized and built into both product development and diffusion. The role of diffusion intermediaries or "information priests" is especially important. 2) Diffusion strategies need to take into account the fact that innovations are frequently evolving

technologies; therefore the adoption decisions for early and later adopters are not identical; the encouragement of "repeat tryers" can be important. 3) Horizontal diffusion of innovations among peers and especially of the new skills necessitated by adoption, may be more appropriate than vertical diffusion. However, peer counselors need to be provided with adequate resources and incentives. 4) The presence, absence and nature of supporting infrastructure influences the pattern of diffusion.

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